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EFFECT OF SALT WATER INFLOW TO THE BALTIC SEA ON THE SPAWNING CONDITIONS OF FLOUNDER (*PLATICHTHYS FLESUS* (L.)) IN THE GULF OF FINLAND

by

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Abstract.

Salt water inflow to the Baltic Sea increases density of the sea water, concentration of O_2 in deep layers, decreases concentration of H_2S in deep layers and it can effect mortality of eggs of flounder. Flounder is composed of two reproductively isolated races in Estonian waters: *P.fl.trachurus* natio *baltica* infranatio *pelagicus* and *P. fl. trachurus* natio *baltica* infranatio *sublitoralis.* The first infranatio spawns in the deep regions of the Baltic Sea and it s eggs are found in the western part of the Gulf of Finland at depths 100 - 140 m . The latter spawns at depths 2 - 22 m and grows more slowly than the first. The eggs of the infranatio *pelagicus* are pelagic and the eggs of the infranatio sublitoralis are demersal. Abundance of the pelagic eggs and larvae increases in the years of salt water inflow to the Baltic Sea from the North Sea. A strong linear correlation was found between salinty in the Gotland Deep and the landings in the Estonian Economic zone in the Gulf of Finland some years later.

Introduction.

Recruitment of flounder is not only a function of spawning stock size but also of biotic and abiotic factors. Spawning stock size itsself is a function of previous recruitment, natural and fishing mortality. The landings of flounder in the Gulf of Finland have decreased from a level of 1226 t in 1984 to 49 t in 1994 , but abundance of the flouder has remained on a very low level. Therefore the investigations of the causes of the decrease were focused on the abiotic factors. Salt water inflow to the Baltic Sea is one of the major reasons of the changes of abiotic factors in the Baltic Sea.

Material and Methods.

Official statistics of the catches of flounder in the Gulf of Finland from 1974 to 1994, age composition in commercial catches, mean size at age, trawl surveys, the data of migrations of the flounder (Витинш, 1976) saline water inflow to the Baltic Sea (Astok et al., 1990; Schulz, Nehring, 1991), VPA (Komissarov, unpubl. data) and abundance of pelagic flounder eggs and larvae (Гаумаи, 1981) were used for study. Trawl surveyes with mesh size 14 mm (knot to knot) have been carried out in January, February, March, April, October, November 1993 and in August 1994 in the Gulf of Finland near Tallinn at depths of 5 - 38 m . Once in February 1993 the mesh size was 24 mm (knot to knot). The trawling velocity was about 4 km/h. The exact size of the trawl was not known, but the width of the trawl was approximately 18 m .

Most part of the catches from 1991 - 1995 were got by traps. The catch was dealt with standard methods: sorted to sex , measured ,weighted and samples of otoliths were taken . All the specimen, included the fish whose length was under the legal for commercial catches, were analysed. Age of flounder was determined by visual method

using optical microscope. The efficiency of age determination of flounder is unknown. About 1000 specimen of flounder were analysed every year from the Gulf of Finland. In 1980 - ies the most part of commercial flounder landings were done by trawlings. Decrease of the abundance of flounder in the Gulf of Finland made the trawlings economically unproductive so in the lattest years flounder was caught mainly by traps and nets in the Gulf of Finland. The flounder analyses before the year 1991 were done by P. Komissarov (unpubl. data).

Results.

In the Gulf of Finland commercial landings of flounder were 173 t in 1974 by Estonian fishermen; further they increased up to 1226 t in 1984 and decreased again to 140 t in 1990 and 49 t in 1994 (Fig.1). The trawlings near Tallinn in 1993 and 1994 show very low abundance of flounder. The total catch of flounder in 1993 was 15.8 kg and the total duration of trawlings was 11.4 hours (1.4 kg per 1 hour). The fishermen said that in 80 - ies they got over 1000 kg of flounder per 1 trawling (about per 1 hour).

3 - 6 years old flounders predominate in the flounder catches in the Gulf of Finland. Flounder attains the legal (minimum) size at the age of 3 years. According to VPA performed by P. Komissarov and R. Aps in 1990 the abundance of flounder was due to increase in the beginning of 90 - ies , but it was not. No linear correlation was found between the abundance of younger flounder in the commaerial catches and the flounder catches in the successive years or the correlation is possibly fluctuating (periodical function).

Grauman (Граман , 1981) found that in years of inflow of saline water from the North sea the abundance of pelagic flounder eggs and larvae in the Baltic increases and so

does the size of the areas with the flounder eggs and larvae. In years between the inflows of saline water the abundance of eggs and larvae decreases and so do the areas in which the eggs and larvae are found . He also mentioned that salinity effects the swimming ability of the eggs. It is known that density of sea water depends mainly on salinity.

A strong linear correlation was found between the salinity in the surface level in the Gotland Deep (Schulz, Nehring, 1991) in certain year and the catches of Estonian flounder in the Gulf of Finland 3,4,5 and 6 years later . We can also find the linear correlation between the salinity in the bottom layer in the Gulf of Finland (Astok et al., 1990) in certain year and the catches of flounder in the Gulf of Finland seven years later, from this year.

Discussion.

Resource of flounder in Estonian waters is composed of two reproductively isolated races (Mikelsaar, 1984): *P. fl. trachurus* natio *baltica* infranatio *pelagicus* and *P. fl. trachurus* natio *baltica* infranatio *sublitoralis* . The first infranatio spawns in deep regions of the Baltic Sea and has a faster growth rate. Its eggs are pelagic. The latter spawns in sublittoral areas and grows more slowly than the first. Its eggs are demersal. In Estonia infranatio *pelagicus* dominates in the commercial catches (Mikelsaar, 1994). Mortality of the eggs of the infranatio *pelagicus* can be dependent on the salinity. In the lower salinity conditions the density of sea water decreases and so does the swimming ability of the eggs. The eggs fall to the deeper layers of water where the conditions for survival are worse. In the conditions of higher salinity , the swimming ability of eggs are better and conditions for survival in more surface layers are better accordingly. The

mean value of the salinity in south- eastern Gotland Sea in the winter surface layer was about 7.3 ‰ (Shulz , Nehring,1991).: Then it increased and in 1978 attained its maximum level 8.05 ‰. Then it decreased and in 1989 the mean value was about 7.6 ‰. In deep water (100 m) the trend was the same. According to the data of V.Astok et al. (1990) the mean values of the salinity in the bottom layer of the Gulf of Finland increased from 9.2 ‰ in 1969 to 10.2 ‰ between 1976 and 1977 and then decreased to 8.4 ‰ in 1988. In surface layer this trend was absent. About 7 years after the year of maximum salinity in bottom layer the maximum flounder landings in the Gulf of Finland were recorded. The eggs of the flounder infranatio *pelagicus* were also found in the western part of the Gulf of Finland (Раумаа,1981) at the depths of 100 - 140 m. No data are recorded in which layers of water the eggs were found. The problem can be more complex. Concentration of H_2S in deep layers and other factors can effect the survival of the eggs and larvae.

According the data of N. Mikelsaar (1984) the migrations of the infranatio *pelagicus* can be 400 - 700 km and the population of the Gulf of Finland is connected with the spawning grounds of the Gotland Deep. This could be the explanation of why the abundance of young flounders and quantity of flounder landings in next years does not have a linear correlation. Vitinsh (Витиньш,1976) found that the distances of spawning - feeding migrations are usually not over 50 - 60 miles.

The main conclusion of this paper can be summarized as follows:

1. The iflow of the saline water from the North Sea to the Baltic Sea can be one of the important reasons of the fluctuations of the abundance of flounder in the Gulf of Finland.

2. The inflow effects the reproduction of the infranatio *pelagicus* which dominates in the Estonian commercial landings in the Gulf of Finland.

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Fig. 1. Estonian flounder landings in the Gulf of Finland in 1974 - 1994